General Chemistry

Description of the Examination

The Subject Examination in General Chemistry covers material usually taught in a one-year introductory course in general chemistry. Understanding of the structure and states of matter, reaction types, equations and stoichiometry, equilibrium, kinetics, thermodynamics, and descriptive and experimental chemistry is required, as is the ability to interpret and apply this material to new and unfamiliar problems.
Battery-operated, hand-held calculators may be used during the exam; however, all calculator memories must be cleared of programs and data, both before and after the exam. It may be helpful to use a calculator for some questions on the exam. A Periodic Table of the elements is included in the exam booklet.
The exam contains approximately 80 multiple-choice questions to be answered within two separately timed 45-minute periods.

Knowledge and Skills Required

Questions on the exam require candidates to demonstrate one or more of the following abilities.

- Recall: remember specific facts; demonstrate straightforward knowledge of information and familiarity with terminology
- Application: understand concepts and reformulate information into other equivalent terms; apply knowledge to unfamiliar and/or practical situations; solve mathematical problems
- Interpretation: infer and deduce from data available and integrate information to form conclusions; recognize unstated assumptions

The subject matter of the General Chemistry exam is drawn from the following topics.

Approximate Percent of Examination	
20%	Structure of Matter
19%	States of Matter
38%	Reactions
14%	Descriptive Chemistry
9%	Experimental Chemistry

Approximate Percent of Examination 20% Structure of Matter

Atomic theory and atomic structure
- Evidence for the atomic theory
- Atomic masses; determination by chemical and physical means
- Atomic number and mass number; isotopes
- Electron energy levels: atomic spectra, quantum numbers, atomic orbitals
- Periodic relationships including, for example, atomic radii, ionization energies, electron affinities, oxidation states

Chemical bonding

- Binding forces
- Forces within species: covalent, ionic, metallic
- Intermolecular forces: hydrogen bonding, dipole-dipole, London dispersion forces
- Relationships to states, structure, and properties
- Polarity of bonds, electronegativities
- Molecular models
- Lewis structures
- Valence bond theory; hybridization of orbitals, resonance, sigma and pi bonds
- VSEPR
- Geometry of molecules, ions, and coordination complexes; dipole moments of molecules; relation of properties to structure

Nuclear chemistry: nuclear equations, half-lives, and radioactivity; chemical applications

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19% States of Matter

Gases

- Laws of ideal gases; equations of state for an ideal gas; partial pressures
- Kinetic-molecular theory
- Interpretation of ideal gas laws on the basis of this theory
- Avogadro's hypothesis and the mole concept
- Dependence of kinetic energy of molecules on temperature
- Deviations from ideal gas laws

Liquids and solids

- Liquids and solids from the kinetic-molecular viewpoint
- Phase diagrams of one-component systems
- Changes of state, including critical points and triple points
- Structure of solids; lattice energies

Solutions

- Types of solutions and factors affecting solubility
- Methods of expressing concentration
- Raoult's law and colligative properties (nonvolatile solutes); osmosis
- Non-ideal behavior (qualitative aspects)

38% Reactions

Reaction types (12%)

Acid-base reactions; concepts of Arrhenius, Brönsted-Lowry, and Lewis; amphoterism; coordination complexes

Precipitation reactions

Oxidation-reduction reactions

The role of the electron in oxidation-reduction

Electrochemistry: electrolytic and voltaic cells; Faraday's laws; standard half-cell potentials; Nernst equation; prediction of the direction of redox reactions

Equations and Stoichiometry (10%)

The mole concept; Avogadro's number

Ionic and molecular species present in chemical systems; net ionic equations

Balancing of equations including those for redox reactions

Mass and volume relations with emphasis on the mole concept, including empirical formulas and limiting reactants

Equilibrium (7%)

Concept of dynamic equilibrium, physical and chemical;

Le Chatelier's principle; equilibrium constants

Quantitative treatment

Equilibrium constants for gaseous reactions in terms of both molar concentrations and partial pressure (Kc, Kp)

Equilibrium constants for reactions in solutions

Constants for acids and bases; pK; pH

Solubility product constants and their application to precipitation and the dissolution of slightly soluble compounds

Common ion effect; buffers; hydrolysis

Kinetics (4%)

Concept of rate of reaction

Use of differential rate laws to determine order of reaction and rate constant from experimental data

Effect of temperature change on rates

Energy of activation; the role of catalysts

Thermodynamics (5%)

State functions

First law: heat of formation; heat of reaction; change in enthalpy; Hess's law; heats of vaporization and fusion

Second law: free energy of formation; free energy of reaction; dependence of change in free energy on enthalpy and entropy changes

Relationship of change in free energy to equilibrium constants and electrode potentials

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14% Descriptive Chemistry

The accumulation of certain specific facts of chemistry is essential to enable students to comprehend the development of principles and concepts, to demonstrate applications of principle, to relate fact to theory and properties to structure, and to develop an understanding of systematic nomenclature, which facilitates communication. The following areas are normally included on the exam.

Chemical reactivity and products of chemical reactions

Chemistry of the main groups and transition elements, including typical examples of each

Organic compounds as exemplary material in areas such as bonding, acid-base reactions, structure, solutions, intermolecular forces

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9% Experimental Chemistry

Some questions are based on laboratory experiments widely performed in general chemistry and ask about the equipment used, observations made, calculations performed, and interpretation of the results. The questions are designed to provide a measure of students' understanding of the basic tools of chemistry and their applications to simple chemical systems.

Study Resources

Textbooks that are frequently used in first-year chemistry courses can help you to prepare for the General Chemistry exam. You can find college-level general chemistry textbooks at most college bookstores. When selecting a textbook, check the table of contents against the "Knowledge and Skills Required" section.
Because textbooks vary in their approach and emphasis, you should consult more than one textbook.